Development of Low-Cost Conformable Storage to Maximize LPG Vehicle Range

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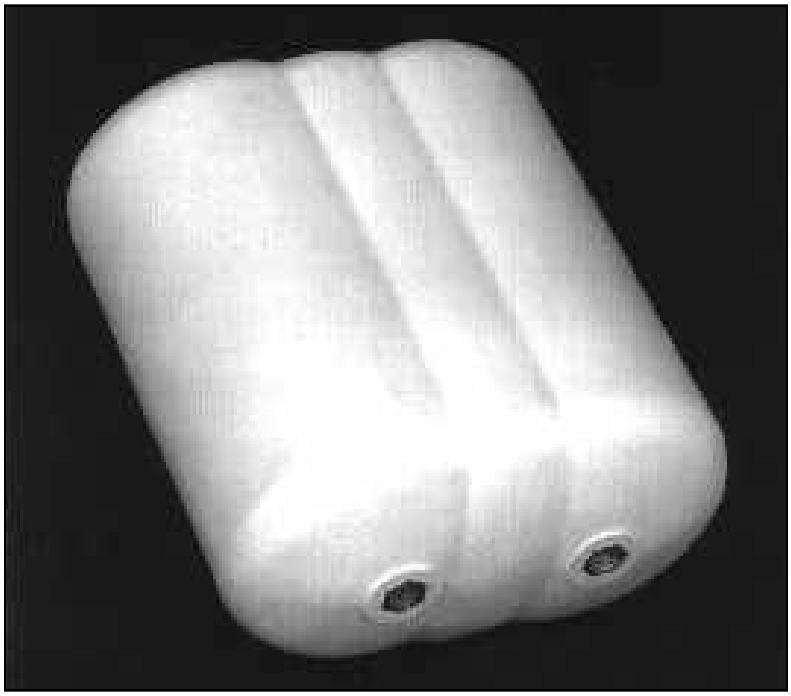
Objective

To develop and demonstrate the feasibility of a low-cost, injection-molded, conformable (noncylindrical) storage system for propane.



Prototype thermoplastic conformable propane tank

Approach

Thiokol will design, fabricate, and test a prototype injection-molded, conformable propane tank. The space-efficient shape of the tank stores up to 40% more fuel in the same storage envelope than cylinders. Thiokol has proven the shape concept and is in production with a metal version of the tank. This program will develop the design, materials, and processing technology to use engineering thermoplastic materials and injection molding processes. The resulting tank is projected to cost 40%-60% less than the welded metal structure currently used. Key technical challenges include attaining adequate as-molded material strength, dealing with the anisotropic properties of engineering thermoplastics, meeting damage tolerance requirements, and selecting the optimum fabrication method. Subscale tanks will be fabricated and tested to demonstrate performance.

Accomplishments

Thiokol has evaluated existing thermoplastic materials, designed a subscale tank, and fabricated and tested several of the subscale tanks. Tank burst pressures were lower than planned, and it was found that the effective material strength as molded in the tanks was lower than expected. New tank designs were prepared for both subscale and full-scale tanks based on the measured effective strength. These tanks have lower volume efficiency and require more material than desired, indicating that more effort will be needed in increasing the effective material strength in the tanks.

Future Direction

Future work will concentrate on achieving a higher effective material strength in the tanks. Material screening will be redone based on new requirements for strength and toughness, looking in particular for materials with high strength transverse to the direction of molding flow. The molding process will also be examined to determine whether the strength of the part can be improved by controlling the molding flow directions and the resulting orientation of the anisotropic material properties. The feasibility of adding additional reinforcement will also be investigated.

Work will also be done to evaluate the potential for using a thermoplastic welding process to assemble tanks molded in more than one piece. Welding will be tested first on small cups, which will be tested for leakage and burst strength. Then, subscale tanks will be cut in half and reassembled by welding. Some of these welded tanks will be tested for leakage, pressure cycling, and burst strength. Others will be dissected for lab tests of the weld.

Publications

None to date.

Comparison of Labor and Materials Costs for Various Materials